Buoyancy Example #2

2002 AP # 6

(a) - hang the mass from a spring & measure the length of the spring.
- measure the unstretched length.
- Subtract stretched − unstretched = Δx
- $F_{sp} = mg = K\Delta x$, so ~~Δx~~ $K = \frac{mg}{\Delta x}$

(b) The spring stretches less. There is now a buoyant force directed up acting on the object. The new ΣF equation now is

$F_{sp} = mg - F_B$. If F_{sp} decrease so does Δx, since k is constant.

(c) When stationary, $F_B + F_{sp} = mg \Rightarrow F_B = mg - F_{sp}$

F_B also equals $\rho_\ell V g$. $\rho_\ell V g = mg - F_{sp}$

$V_{in} = V_0$ when submerged. $\rho_\ell = \frac{mg - K\Delta x}{V_0 g}$ (eq 1)

Known: m, g, ρ_0.

Calculated K in part (a).

$V_0 = \rho_0 / m$

if we measure Δx, we know everything in (eq 1) and we can find ρ_ℓ.

Symbol	quantity
m	mass of object
g	$g = 9.8 \frac{N}{kg}$
K	Spring constant from part (a)
Δx	difference in stretched & unstretched spring length
V	volume of object (and displaced fluid when submerged)
ρ_0	density of object
F_B	Buoyant force
F_{sp}	Spring force
$F_g = m_{fl} g$	weight of fluid